Eggs of the Oriental Fruit Fly for Rearing the Predacious Anthocorid, *Orius insidiosus* (Say)[1]

JOHN TAKARA AND TOSHIYUKI NISHIDA[2]
UNIVERSITY OF HAWAII, HONOLULU, HAWAII 96822

The anthocorid, *Orius insidiosus* (Say), is a common predator in many agricultural ecosystems such as corn, alfalfa and cotton. Its value as a biological control agent has been mentioned by Phillips and Barber (1933), Sweetman (1936) and Dicke and Jarvis (1962) among others. Listed among its prey are such pests as thrips, mites, aphids and the larvae and eggs of Lepidoptera.

In the laboratory *O. insidiosus* has been reared on natural prey by Barber (1936) and Garman and Jewett (1914). Recently, we found that this predator could be reared on the eggs of the oriental fruit fly, *Dacus dorsalis* Hendel, which are not attacked under field conditions. This paper is concerned with the use of this factitious prey as a rearing medium for *O. insidiosus.*

MATERIALS AND METHODS

Rearing

A laboratory colony of *O. insidiosus* was started from the progeny of field-collected adults. Snap-cap polyethylene vials, 2.6 x 6.9 cm were used as rearing containers. The vials were ventilated with a 1 cm hole in the caps covered with single knit cotton cloth.

To obtain eggs of the predator, shoots of watercress, *Nasturtium officinale* R. Br., were used as an oviposition substrate. Eggs were dissected from the shoots and placed on a square of filter paper in each rearing vial. The filter paper squares were moistened daily until hatching to prevent dessication of the eggs.

After the nymphs emerged, 10 fruit fly eggs were placed daily into each vial containing a single individual to ensure an ample food supply. Data on growth and development of the nymphs were recorded daily. After the adults emerged, males and females were paired in rearing vials. Watercress shoots were placed in each vial and the number of eggs laid in them recorded daily.

Evaluation of Diet

Inadequate food quality may result in abnormal individuals exhibiting diminished size, retarded development and reduced fecundity (House, 1963). Therefore, in this study assessments of the nutritive value of *D. dorsalis* eggs were made using growth, development rate and fecundity as evaluation criteria. Growth comparisons were made between field-collected individuals that had fed on a natural diet and the laboratory

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individuals reared on fruit fly eggs. Increments of body and metafemur length were used as indices of growth between succeeding instars. The field collection of 20 individuals of each instar was taken from corn in the silking stage of development. The nymphs were killed in 70% alcohol before measuring. Development rate and fecundity were evaluated by comparing observations on individuals fed fruit fly eggs in the present study with observations reported by Barber (1936), who reared *O. insidiosus* on aphids and Lepidoptera eggs, and Iglinsky and Rainwater (1950), who used a diet of a mite, *Septanychus* sp. Development rate was compared using degree-day developmental requirements, calculated from temperature records and development times reported in these studies.

Results

Feeding Observations

All stages of *O. insidiosus* fed readily on the fruit fly eggs (Figure 1).

FIG. 1. Fourth instar nymph of *O. insidiosus* feeding on an egg of *D. dorsalis*.

There were differences in the appearance of eggs attacked by the predator. Eggs from which the contents had been completely eaten were flattened, whereas those whose contents had been partially consumed were flaccid and wrinkled. The extent of feeding varied with the age of the predator. The first instar nymphs consumed only a fraction of the contents of an egg each day, whereas older nymphs consumed larger portions. The adults required the equivalent of approximately 3 eggs per day.

Evaluation of Diet

The growth comparison between the metafemur lengths of the field and laboratory individuals is shown in Figure 2. It shows that metafemur lengths in the two groups were similar. Indeed, there was no difference in the average lengths of the 1st, 3rd and 4th instars. Although differences between the means were observed in the 2nd and 5th instars, t-tests showed that these differences were statistically insignificant at the 1% level of significance. Figure 2 also shows that increments in metafemur length between successive instars of the two groups were similar. For this reason linear regression coefficients were calculated for the relationship between instar and the logarithms of metafemur length. The values were 0.104 for the laboratory nymphs and 0.108 for the field-collected nymphs. Again, a t-test showed that the difference was not statistically significant at the 1% level of significance. Similar results were obtained with the body length comparisons. These results indicate that the growth of individuals reared on fruit fly eggs was comparable to growth of individuals which had fed on a natural diet.

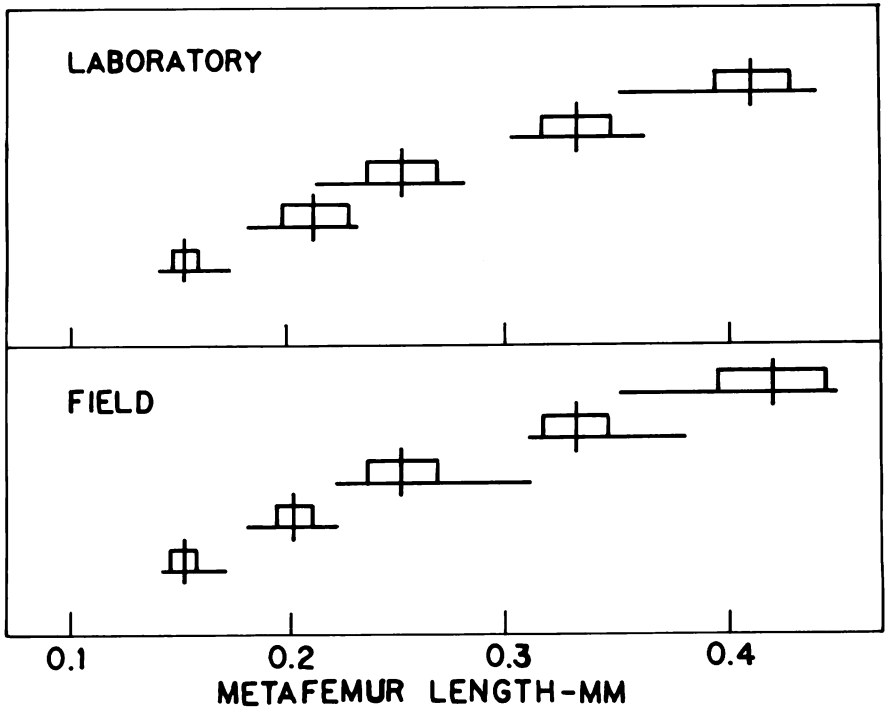

FIG. 2. Growth comparison between field individuals that had fed on a natural diet and laboratory individuals reared on *D. dorsalis* eggs. The horizontal lines represent the ranges, the vertical lines, the means, and the rectangles, the standard deviations of the metafemur lengths of individuals in each of the five instars. The number of nymphs measured ranged from 8 to 20.

Other assessments of the nutritive value of *D. dorsalis* eggs were made by comparing the results of the present study with other studies reporting development rate and fecundity of *O. insidiosus* reared on various natural prey. Again, the fruit fly eggs compared favorably with natural hosts. It was found that the degree-day energy requirements for development of the nymphs reared on fruit fly eggs were nearly identical to those observed for individuals reared on *Septanychus* sp. Furthermore, average egg production per female was comparable to that observed for females fed Lepidoptera eggs and greater than observed on a diet of aphids. In addition the daily egg production rate was higher with fruit fly eggs than observed with any of the natural prey. Although reduced longevity was observed when fruit fly eggs were used as food, this reduction may be inversely related to the high egg production rate.

Thus, overall, the evidence concerning growth, development and fecundity indicates that *D. dorsalis* eggs, a factitious host, is nutritionally comparable to natural hosts of *O. insidiosus.*

Discussion

One of the major problems with rearing entomophagous insects is the provision of adequate amounts of hosts. Because natural hosts are often difficult to collect or rear, the use of factitious hosts may be a solution, particularly when convenient methods have been developed for rearing them.

Convenience was the primary advantage for using *D. dorsalis* eggs as a food source in the present study. The eggs were available from the USDA Fruit Fly Investigations Laboratory in Honolulu, Hawaii, where the fly is mass-reared on an artificial diet (Mitchell et al., 1965; Tanaka et al., 1969). The eggs were also simple to use. They required no prior treatment and were conveniently acceptable to the predators on squares of filter paper. In addition, they remained usable as food for up to 3 weeks, if necessary, when stored in water and refrigerated at 3°C. Storage in water, furthermore, allowed for simple methods to allot numbers of eggs. In the present study, where 10 eggs were used per individual, the eggs were dispensed with an eyedropper. If larger numbers were to be used, for example in mass-culturing, the eggs could easily be allotted volumetrically, 18,500 eggs per ml, drained (Tanaka, pers. comm.).

Notwithstanding the importance of convenience, the nutritional value of factitious hosts should be of concern. Not only do the results of this study demonstrate that a factitious host may indeed be more convenient to use than natural hosts but furthermore, that such a host can be nutritionally comparable to a natural diet.

In addition to *O. insidiosus*, the eggs of *D. dorsalis* have been used to rear nymphs of the sugarcane leafhopper egg sucking bug, *Tytthus mundulus* (Breddin), a predacious mirid (Taniguchi, pers. comm.) and *Paratriphleps laevisculus* Champion, another anthocorid. It is likely that other entomophagous species may also be reared on the eggs of this fruit fly.

Although the availability of *D. dorsalis* eggs may be limited, other species of flies are common laboratory animals, many with well-developed rearing methods (see Woodbury, 1943). It is conceivable that the eggs of such species may also be suitable for rearing entomophagous insects with feeding habits similar to *O. insidiosus.*

ABSTRACT

Orius insidiosus (Say), a predatory anthocorid, was reared on a factitious host, eggs of the oriental fruit fly, *Dacus dorsalis* Hendel. Comparisons of growth, development and fecundity revealed no differences with individuals fed natural diets. It was concluded that the eggs were nutritionally adequate for the rearing of normal individuals. In addition to *O. insidiosus*, nymphs of two other predacious heteropterans, *Tytthus mundulus* (Breddin) and *Paratriphleps laevisculus* Champion, were successfully reared to adulthood on the eggs. Conceivably, the eggs of *D. dorsalis* or other species of flies may be used as hosts for entomophagous insects with feeding habits similar to *O. insidiosus*.

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